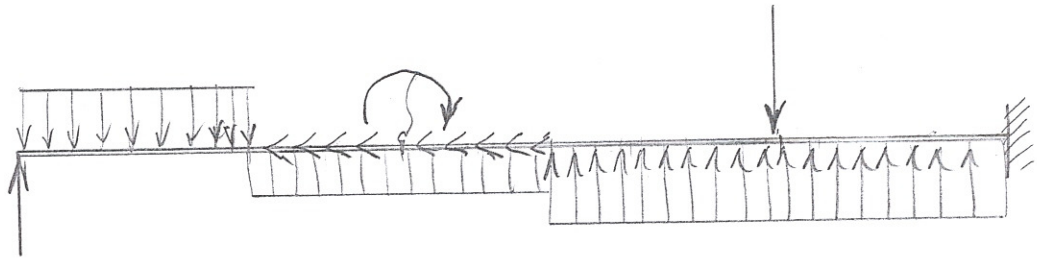
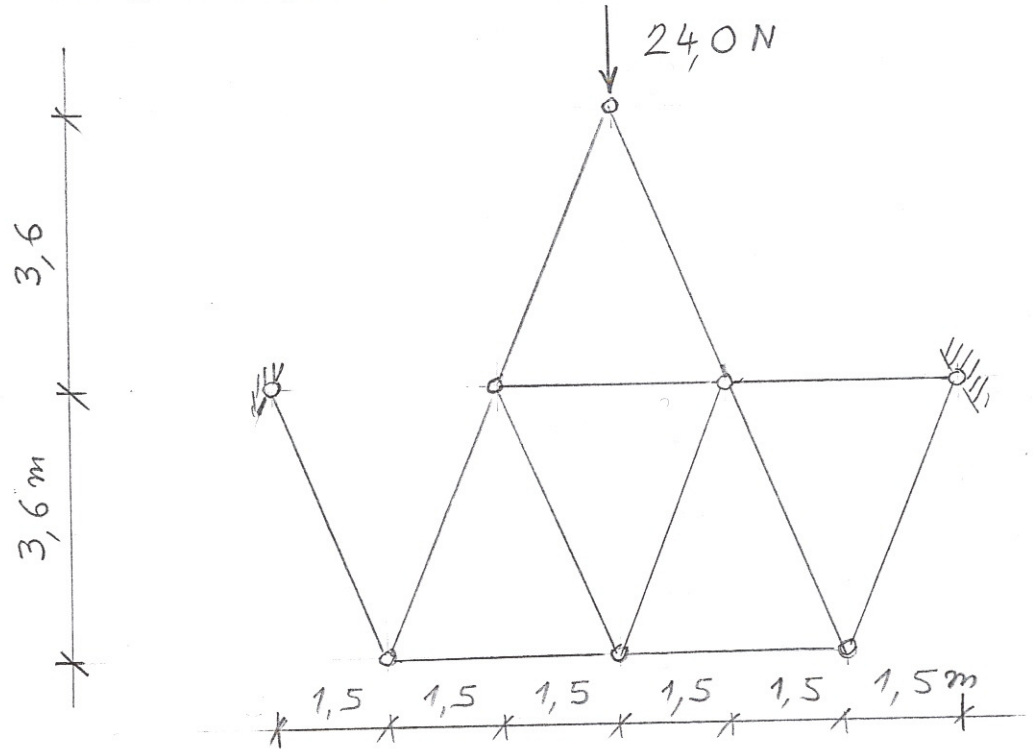
1. Zadan je vektor sile $\vec{F} = 21 \cdot \vec{i} - 17 \cdot \vec{j} - 9 \cdot \vec{k}$. Treba odrediti vektor momenta sile na točku T: $\vec{M}_T^F$, pri čemu je geometrijski vektor zadan: $\vec{l} = 4 \cdot \vec{i} - 5 \cdot \vec{j} + 6 \cdot \vec{k}$. Treba odrediti $|\vec{M}_T^F|$ i provesti kontrolu pomoću izraza koji povezuje aspolutne iznose: $|\vec{M}_T^F| = |\vec{l}| \cdot |\vec{F}| \cdot \sin\alpha$

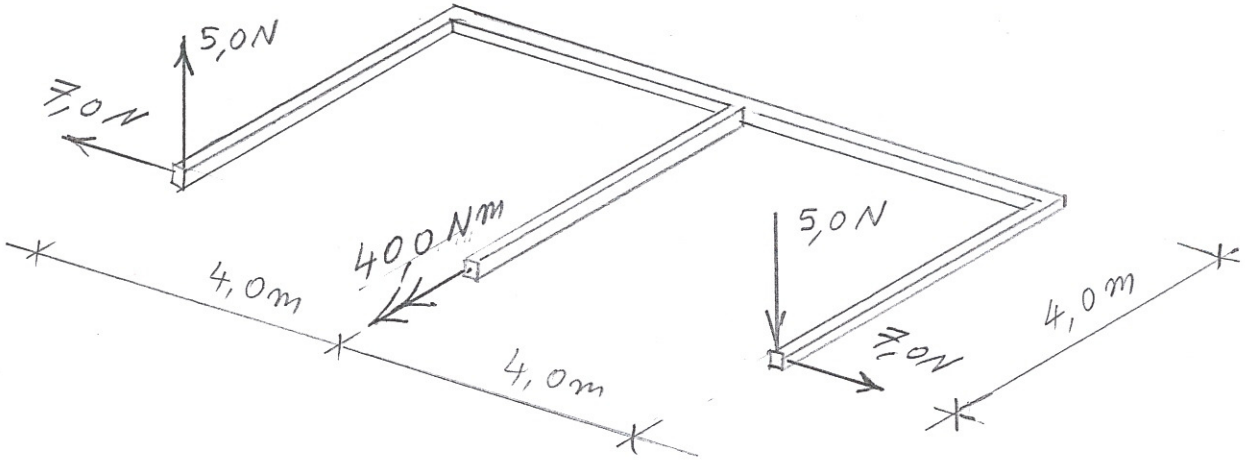
2. Treba samo kvalitativno, bez proračuna prikazati M dijagram prikazane konzole. Iz opterećenja i M dijagrama treba odrediti T dijagram. Analogno treba odrediti i N dijagram, te skicirati odgovarajuću orjentaciju djelovanja u spojevima. Treba crtati ravnalom.



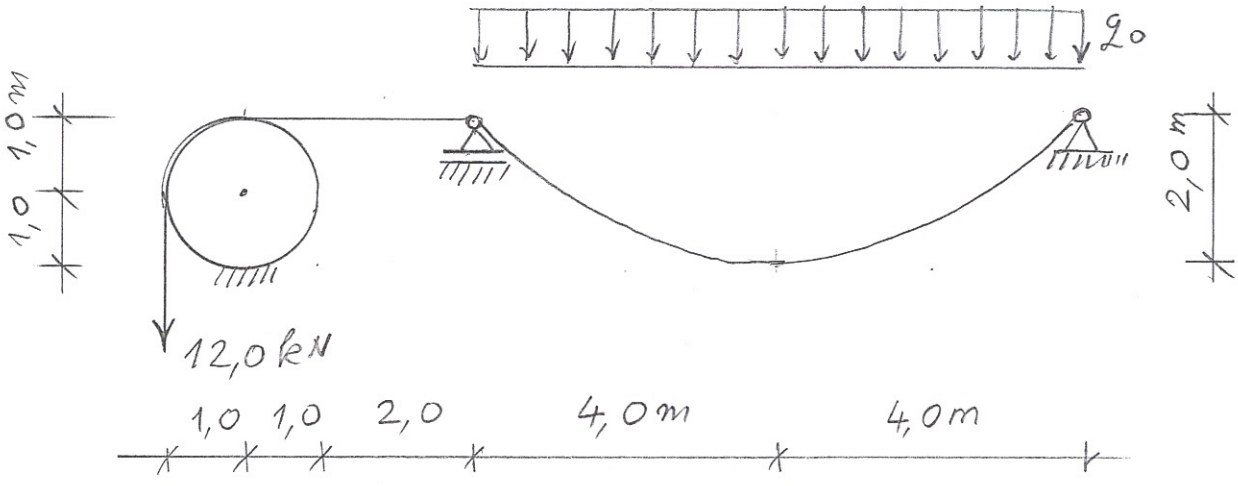
3. Treba na propisani način odrediti sile u zglobnim štapovima prikazanog ravninskog rešetkastog sustava koji se nalazi u ravnoteži, prikazati rješenje te provesti kontrole.



4. Treba aksonometrijski skicirati sljedeće dijagrame unutarnjih sila prikazanog štapa: M_1, M_2, M_t, N.
M_1 se odnosi na savijanje u ravnini štapa. Priznat će se samo podaci korektno prikazani na dijagramima.



5. Prikazan sustav nalazi se u stanju ravnoteže. Koeficijent trenja između valjka i idealne niti koja je bez težine je zadan: $\mu_0 = 0{,}258128$. Nit jednim krajem djeluje na element pomičnog zgloba. Na taj je element spojena druga nit koja ima oblik parabolične lančanice. Opterećenje q_o reducirano na horizontalu je konstantno. Treba odrediti minimalni i maksimalni iznos q_o uz koje sustav još ostaje u ravnoteži. Rješenje je moguće i bez postavljanja analitičkih izraza za oblik lančanice.



1. $$\vec{M}_T^F = \vec{l} \times \vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 4 & -5 & 6 \\ 21 & -17 & -9 \end{vmatrix} =$$

$$= (45 + 102)\vec{i} + (-36 - 126)\vec{j} + (-68 + 105)\cdot\vec{k} =$$

$$= 147\cdot\vec{i} - 162\cdot\vec{j} + 37\cdot\vec{k} \qquad 3 \times \boxed{2}$$

$$|M_T^F| = \sqrt{147^2 + 162^2 + 37^2} = 221{,}8603 \qquad \boxed{2}$$

$$|\vec{l}| = \sqrt{4^2 + 5^2 + 6^2} = 8{,}77496 \qquad \boxed{2}$$

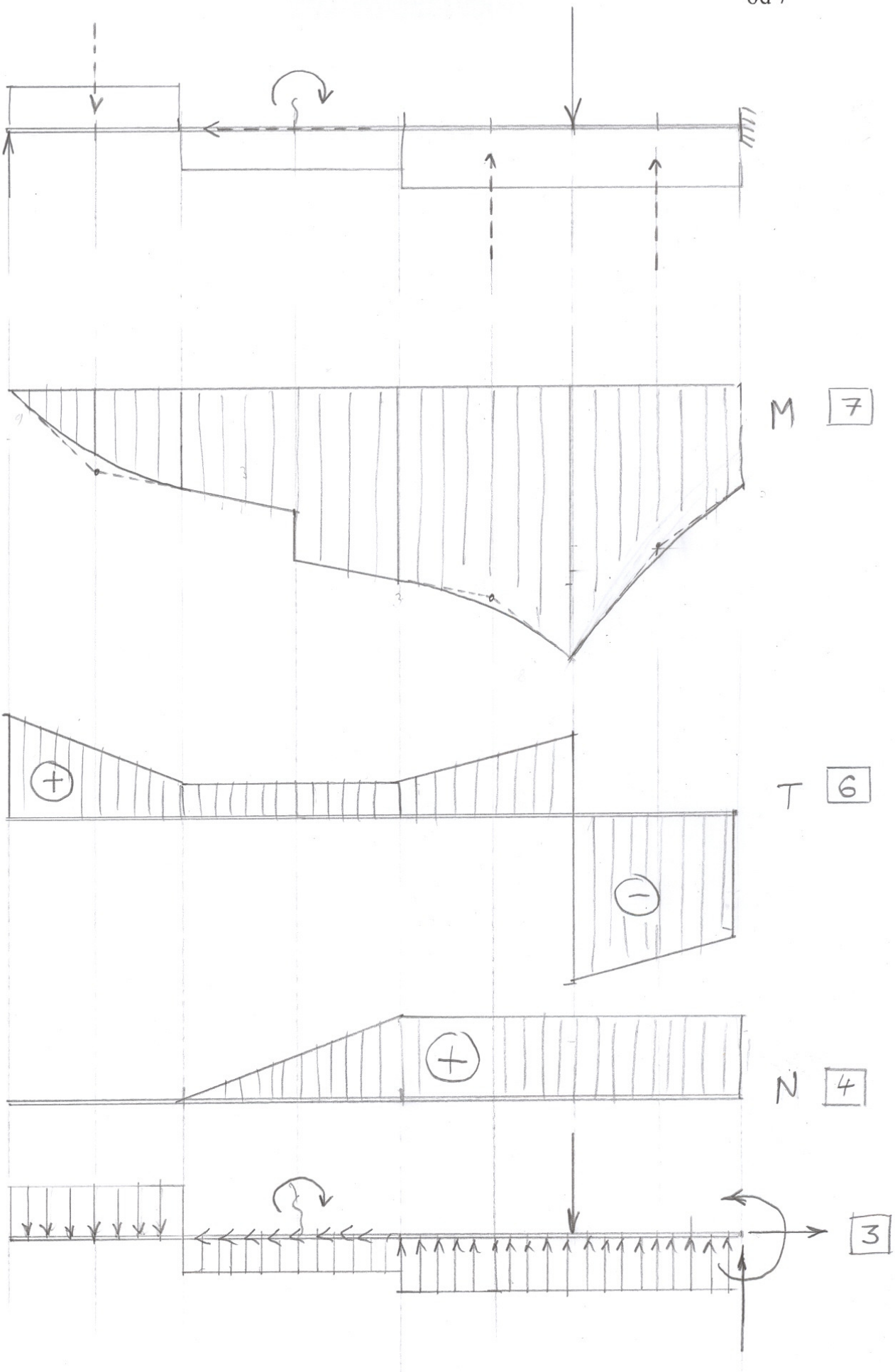
$$|\vec{F}| = \sqrt{21^2 + 17^2 + 9^2} = 28{,}47806 \qquad \boxed{2}$$

$$\cos\alpha = \frac{\vec{l}\cdot\vec{F}}{|\vec{l}|\cdot|\vec{F}|} = \frac{4\cdot 21 + (-5)\cdot(-17) + 6\cdot(-9)}{|\vec{l}|\cdot|\vec{F}|}$$

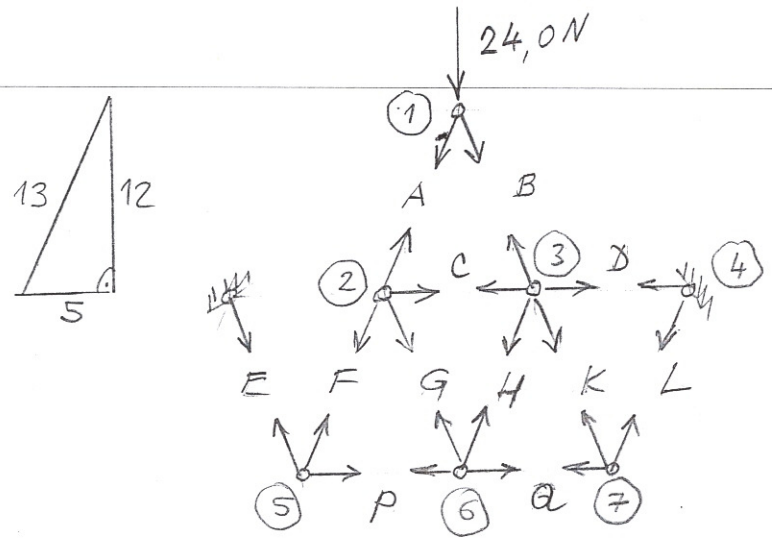
$$\cos\alpha = 0{,}460195 \qquad \boxed{4}$$

$$\sin\alpha = \sqrt{1 - \cos^2\alpha} = 0{,}887818 \qquad \boxed{2}$$

$$|\vec{l}|\cdot|\vec{F}|\cdot\sin\alpha = 221{,}8602\ \checkmark \qquad \boxed{2}$$

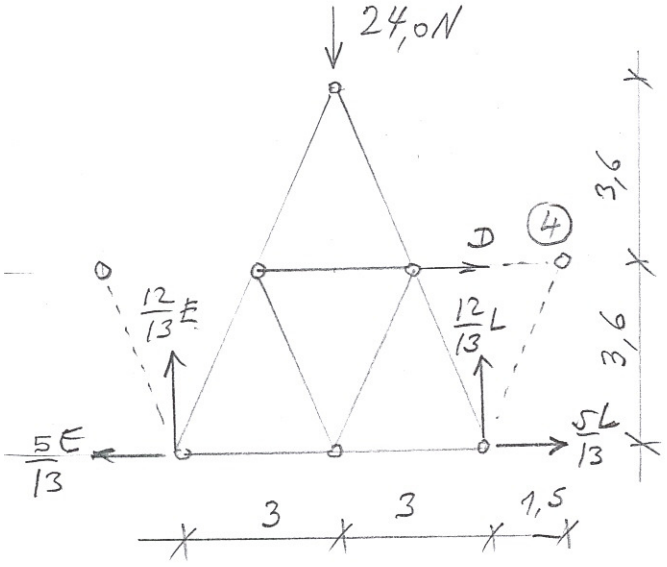

M 7
T 6
N 4
3

3.



2

RAVNOTEŽA REŠETKE (1, 2, 3, 5, 6, 7)



$\sum_{(L)} M_{(4)} = \phi$

$+ 4{,}5 \cdot 24 - E\left(7{,}5 \cdot \frac{12}{13} + 3{,}6 \cdot \frac{5}{13}\right) = \phi$

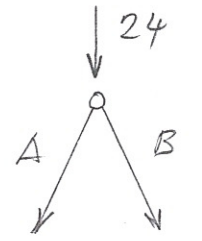
$E = 13{,}0\ N$ 2

$\sum_{()} F_{yi} = \phi$ 2

$\frac{12}{13} E - 24 + \frac{12}{13} \cdot L = \phi$; $L = 13{,}0 N$

$\sum_{()} F_{xi} = \phi$: $D = \frac{5}{13} E - \frac{5}{13} L = \phi$ 1

ČVOR (1)



$\sum F_{xi} = 0$

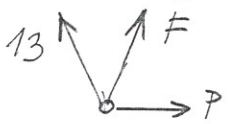
$-\frac{5}{13} A + \frac{5}{13} B = \phi \Rightarrow A = B$ 1

$\sum F_{yi} = \phi$; $-\frac{12}{13} A - \frac{12}{13} B - 24 = \phi$

$A = 13{,}0 N$

$B = 13{,}0 N$ 1

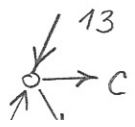
ČVOR (5)



$\sum F_{yi} = \phi$; $\frac{12}{13} \cdot 13 + \frac{12}{13} \cdot F = \phi$; $F = -13{,}0 N$ 1

$\sum F_{xi} = \phi$; $-\frac{5}{13} \cdot 13 + \frac{5}{13} \cdot F + P = \phi$; $P = +10{,}0 N$ 1

ČVOR (2)



SVE SILE OSIM C i G SE PONIŠTAVAJU.

KAKO C i G NISU PARALELNE, SLIJEDI

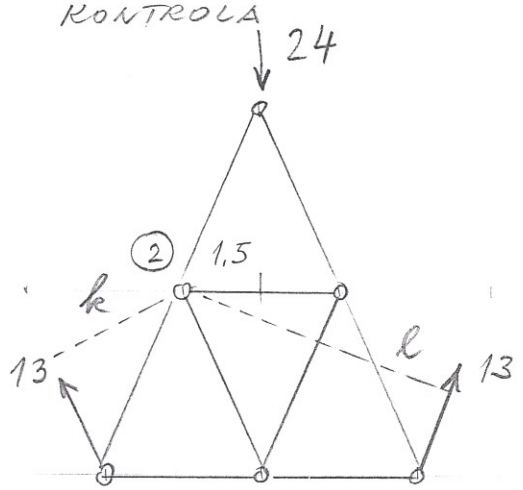
$C = \phi$; $G = \phi$.

UZ SILU $D=0$, RASPORED MORA BITI SIMETRIČAN, PA SLIJEDI: $H=0$; [1]

$K=-13{,}0\,N$ [1]

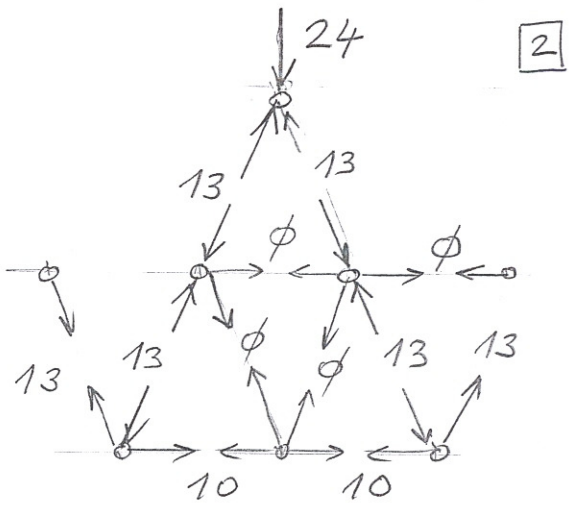
$Q=+10{,}0\,N$ [1]

KONTROLA



$k=\frac{3\cdot 12}{13}$ $\quad \ell=\frac{6\cdot 12}{13}$

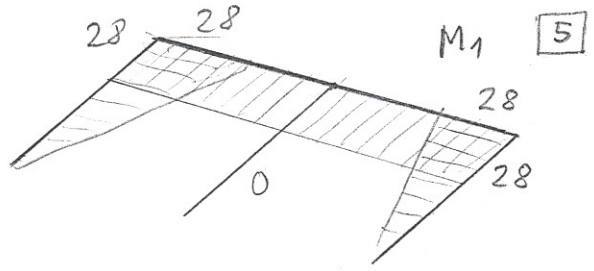
STVARNA DJELOVANJA



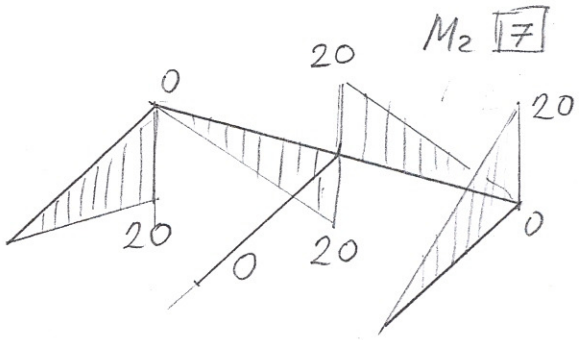
[2]

$\Sigma M_{(2)} = -1{,}5\cdot 24 - \frac{36}{13}\cdot 13 + \frac{72}{13}\cdot 13 = \phi$ [2]

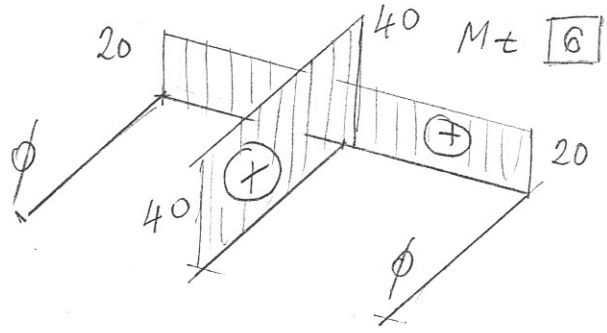
4.



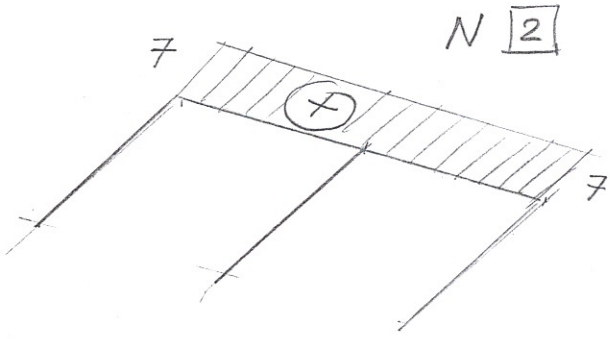
M_1 [5]



M_2 [7]

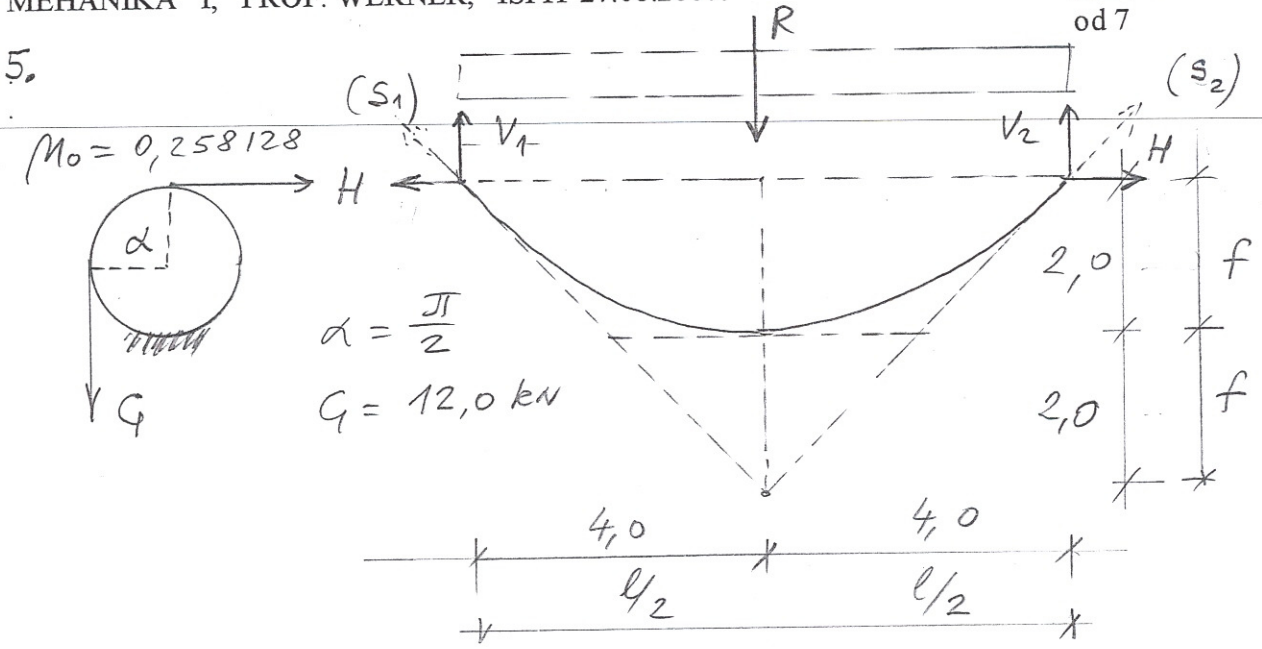


M_t [6]



N [2]

5.



S_1 i S_2 LEŽE NA RUBNIM TANGENTAMA KOJE SE KOD KVADRATNE PARABOLE S POZNATOM SREDNJOM ORDINATOM SIJEKU U TOČKI KOJA JE ZA f UDALJENA SREDNJE TOČKE.

a) $H > G$ $\quad H = G \cdot e^{\frac{\pi}{2}\cdot\mu_0} = 18{,}00\ kN$ [3]

$\frac{V_1}{2f} = \frac{H}{\frac{l}{2}}$; $\quad V_1 = H = 18{,}00\ kN$ [3]

$V_2 = V_1$; $\quad R = 2 \cdot V_1 = 36{,}00\ kN$ [2]

$$q_{0,a} = \frac{36{,}00}{8{,}00} = 4{,}5\ \frac{kN}{m'}$$ [2]

b) $H < G$ $\quad H = \frac{G}{e^{\frac{\pi}{2}\mu_0}} = 8{,}00\ kN$ [3]

$\frac{V_1}{2f} = \frac{H}{\frac{l}{2}}$; $\quad V_1 = H = 8{,}00\ kN$ [3]

$V_2 = V_1$; $\quad R = 2 \cdot V_1 = 16{,}00\ kN$ [2]

$$q_{0,b} = \frac{16{,}00}{8{,}00} = 2{,}0\ \frac{kN}{m'}$$ [2]